

Subduction and exhumation history of the early metamorphic rocks of southern Kamuikotan Zone, Hokkaido, Japan.

*Yuki Furukawa¹, Hayato Ueda¹, Megumi Ozawa²

1. Niigata University, 2. Asano Taiseikiso Engineering Corporation

The Kamuikotan Zone is a Cretaceous to Paleogene low-temperature and high-pressure metamorphic belt that extends from north to south in the central part of the Sorachi-Yezo belt in Hokkaido. The Iwashimizu Complex in the southern part of the Kamuikotan Belt is considered as a Lower Cretaceous accretionary complex, in which the Pirashuke Unit near the structural top show the oldest metamorphic age in the belt as well as amphibolite blocks in serpentine melanges. It is expected that these rocks tell us the timing, thermal structure, and its temporal change just after the subduction initiation. Therefore, we focus on the Pirashuke Unit and surrounding rocks in the Iwashimizu complex.

In the Shizunai-Niikappu area, the Pirashuke Unit is subdivided into units 1 (basalt), 2 (chert, siliceous mudstone, sandstone), 3 (basalt, chert), 4 (lapilli tuff), and 5 (chert) in structurally ascending order, and the top parts are covered by mid-Cretaceous and younger sediments.

Based on equilibria of pumpellyite (P), actinolite (A), alkali pyroxene (N), epidote (E), and sodic amphibolite (R), rocks in this area are classified into PAN type and PNR type. The PAN type rocks occur in the northeastern and southwestern parts, and also locally in the northwestern parts as a wedge. The PNR type rocks occur as a zone between the PAN type rocks from the northwest to the southeast. The PAN type rocks are considered to lie in the structurally higher horizons than PNR type rocks. The Schreinemaker's bundle analysis suggests that the PAN type equilibrium are formed in lower pressure or higher temperature than the PNR type. In the further east (structurally lower), lawsonite-bearing assemblages instead of epidote occurs suggesting lower temperature than both PAN and PNR types.

U-Pb ages were measured for detrital zircons extracted from a sandstone and tuffaceous siliceous mudstone. In the sandstone, the youngest peak peak of ~127 Ma was found in a cluster ranging 120-150 Ma as the older limit of its sedimentary age. Pb-129 zircons showed a single peak with the weighted mean age of 123 Ma as a sedimentary age. Time interval from the sedimentary ages to the metamorphism (~25 km at 125 Ma) for the Pirashuke Unit was no greater than 2 m.y., leading a estimate of the vertical velocity of subduction faster than 10 mm/y. Assuming the minimum slab dip as 45 degrees based on the distance from the Kamuikotan Zone to the eastern margin of the Idonnappu Zone (as the trench site), the subduction velocity of >14 mm/y can also be estimated. The time interval from metamorphism at ~125 Ma to surface erosion with unconformity at 110-105 Ma suggests an exhumation rate of 1-2 mm/y. In the structurally lower Shizunai Unit, vertical subduction rate of ~1 mm/y vertical subduction rate is estimated based on the youngest sedimentary age (~125 Ma) and the metamorphic depth and ages (15-20 km at 110 Ma). The Pirashuke Unit rocks were subducted with a velocity as fast as general plate velocity, while the Shizunai Unit rocks were subducted at a velocity one order of magnitude slower. Therefore, the Pirashuke rocks were probably underplated after subduction together with the slab, while the Shizunai rocks were detached from the slab at shallow levels and then slowly subducted.

Occurrences of higher-temperature PAN-type rocks structurally overlying the PNR type suggest that the hanging-wall wedge mantle was still hot immediately after the subduction initiation. Hornblende crystals in amphibolite blocks of serpentine melange in adjacent area are commonly mantled by actinolite and rimmed by sodic amphibole. This zoning can be correlated with the map-scale zonation of PAN and PNR types. Taking occurrences of lawsonite also into account, the subduction zone was probably deastically refrigerated from amphibolite-grade to lawsonite-grade temperatures in a short period contemporaneously with accretionary growth of the Iwashimizu subduction complex.

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